Biological Control of Flies on Maine Dairy Farms

Results of an On-Farm Demonstration

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Summary

A trial was conducted in 2001 on four organic dairy farms in central Maine to demonstrate the effectiveness of releasing beneficial wasps for management of the house fly. A statistically significant level of fly control was demonstrated in three of the five release barns compared with the untreated barn. Highest levels of fly control were achieved in individual calf hutches where weekly fly control exceeded 80% from late July through August. In barns with free-stalls or pens peak weekly fly control was 18-43% during the same period. All participating producers were satisfied with the results and plan to incorporate the use of fly parasites, along with the use of traps and good cultural practices, into their fly control programs in the future.

Introduction

The house fly (*Musca domestica*) is the most common insect pest occurring on dairy farms in North America. House flies present an annoyance to animals and people resulting in reduced milk production, complaints from neighbors and sometimes legal action. Flies can also carry human and animal pathogens such as *Escherichia coli* and *Salmonella enteriditis* thereby presenting disease threats.

Integrated Pest Management (IPM) is widely recognized as the most effective approach to managing pests while reducing reliance on pesticides. By integrating cultural, biological and other types of practices into farm production and management systems, long-term pest prevention and suppression can be achieved.

In nature, insect pests are often kept in check by natural enemies; so-called 'beneficial organisms' that attack the pests. On the farm nature needs a boost. Fly populations build up quickly where animal manure accumulates and the fly's natural enemies lag behind. Biological control of pests, which can be achieved by augmenting natural enemy populations, has been overlooked as a means of nuisance fly control in Maine dairy production. Research conducted at Cornell University has shown that releases of natural enemies, particularly a species known only by its scientific name - *Muscidifurax raptor*, can serve as an effective component in IPM programs on dairy farms.

Both conventional and organic farmers often cite the need for on-farm demonstrations of alternative production and management practices. Our project was undertaken to demonstrate to Maine farmers the effectiveness of releasing parasitic wasps as part of an IPM program for house fly control in commercial dairy operations.

Methods

Sites. Four commercial organic dairy farms located in central Maine were used for the demonstration project. Herd size ranged from 50 to 150 milking cows plus heifers and calves. Cows were housed in free-stall barns at all of the farms and were also pastured at

three of the four farms. Calves were penned in open barns at three farms and the fourth farm used individual calf hutches held within an open, unfinished barn. *Treatment Barns:* Fly parasitic wasps were released in five different barns located on four different farms. Two of the barns were free-stall barns housing milking cows, one barn housed penned heifers, one held penned calves, and one housed individual calf hutches (10 hutches at start of summer increasing to 20 hutches by mid-summer). *Control Barn*: At one of the farms, a separate free stall-type barn housing about 50 milking cows, located about 100 m. from the wasp-release barn was used as a control barn. Fly activity and natural parasitism were monitored, but no wasps were released in the control barn.

Table 1. Description of demonstration sites.

Barn	Location	Style	Animals
Richmond I	Farm 1	Free-stall & pens	30 milking cows, 12 calves, 2 hogs
Richmond II	Farm 2	Pens	40 calves
Calf-hutches	Farm 3	Individual hutches in barn	20 calves
Turner I	Farm 3	Free-stall	50 milking cows
Heifer	Farm 4	Pens	40 heifers
Control	Farm 4	Free-stall	50 milking cows

Parasitic Wasp Release. Two species, *Muscidifurax raptor and M. raptorellis*, both tiny parasitic wasps in the family Pteromalidae that attack and kill house fly pupae, were purchased from a commercial source (IPM Laboratories, Inc., Locke, NY). Although we ordered *M. raptor* only, the supplier was unable to provide the single species, so the mixture of two closely related species was used instead. Parasites were released in barns and calf hutches at each of the four farms weekly, for 12 weeks beginning 31 May 2001. Each week approximately 10,000 wasps (average mixture of 55% *M. raptor* and 45% *M. raptorellis*) were released at each site. This was done by distributing handfuls of parasitized fly pupae (from which wasp adults were beginning to emerge), throughout the barn, particularly in stall corners, under feed bunks and waterers, and in other protected locations near fly breeding sites, following instructions included and Cornell University guidelines (Rutz et al. 1994, Watson et al. 1994, Kauffman et al. 2000, Waldron et al. 2000).

Monitoring Flies and Parasitic Wasps. Wasp activity was monitored by placing small mesh bags containing fly pupae in the barns. Each week, the bags were replaced with new bags and the old bags were taken back to the laboratory where the pupae were reared to determine how many had been parasitized (killed by the wasps) during their 7-day on-site exposure. Fly activity was monitored by counting the numbers of fly specks deposited on strips of white masking tape that were placed on stalls and walls throughout each barn. The tape strips were replaced weekly.

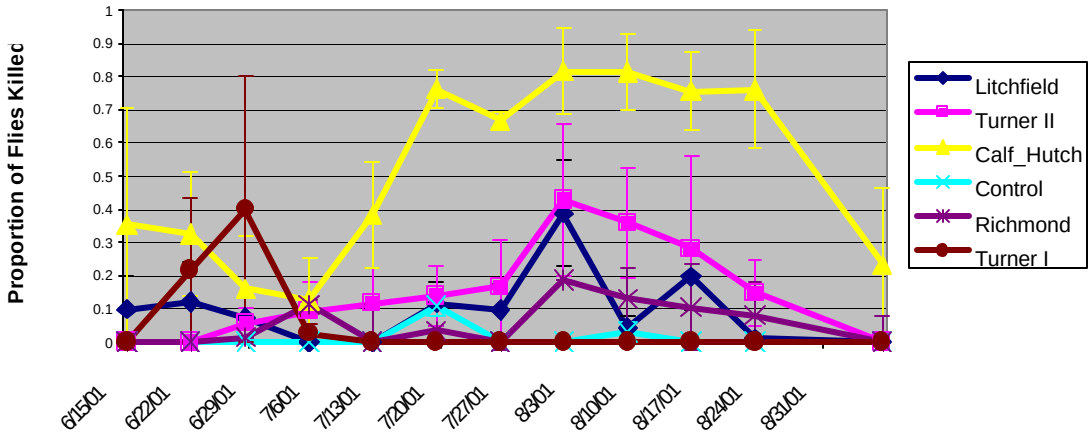
Results

Fly Parasitism. Control of house flies due to the parasitic wasps was evident to some degree in all wasp-release barns. In all wasp-release barns there was an initial rise in

parasitism corresponding to the effect of released wasps and another peak during the first week of August corresponding to wasp population increase. The number of flies killed by the wasps was statistically significant over the entire season in two barns, over part of the season at a third site, and was not statistically significant at two sites.

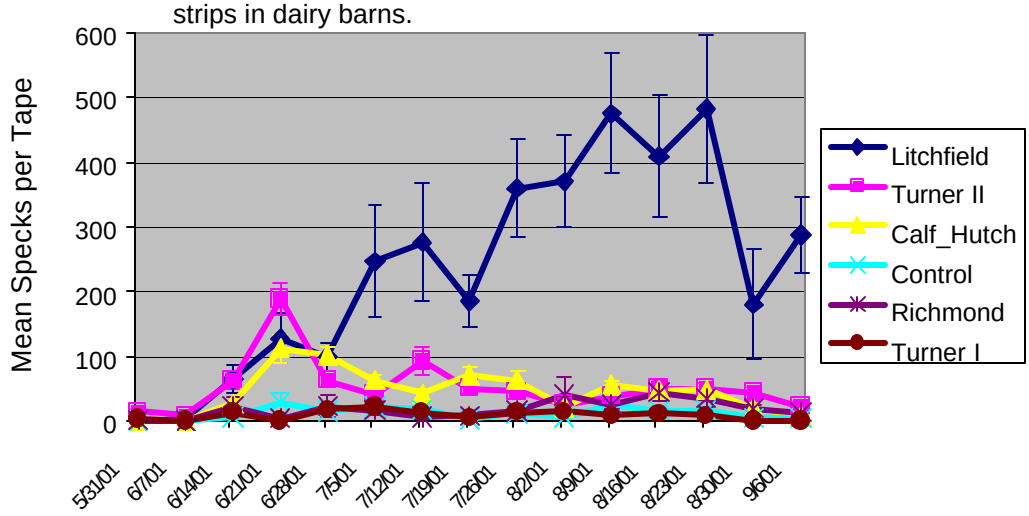
The effectiveness of the wasp release was most evident in individual calf hutches. By midsummer, close observation revealed numbers of the tiny wasps inside the hutches. Parasitism of fly pupae was significantly higher in the calf-hutch barn compared with all other treated barns and the control barn (Figure 1). On average, 51% of the fly pupae placed in the barns for monitoring purposes were killed by wasps in the calf hutches. From late July through August parasitism was greater than 70%. The barn with penned heifers also showed significantly increased parasitism (reaching as high as 43%) compared with the control barn. By comparison, average parasitism of flies by naturally occurring parasitic wasps was only 1% in the control barn.

Figure 1. Mean (+ standard error) weekly proportion of sentinel flies killed by parasitic wasps released in organic dairy barns in biocontrol demonstration program, 2001



Fly Activity. Fly activity, as monitored by speck counts on masking tape strips are shown in Figure 2. Mean speck counts varied greatly among barns. It was apparent that fly activity was largely determined by factors other than wasp release treatment. That is, cultural practices, barn structure, number and age of cows and other environmental factors seemed to have the greatest impact on fly activity.

Figure 2. Mean (± standard error) weekly number of fly specks on tape strips in dairy barns.



In fact, speck counts at the control barn, an open-sided free-stall barn housing milking cows, were quite low compared with two of the four wasp-release barns: the calf hutch barn and the heifer barn. Increased house fly activity in these two barns was not surprising given that fly activity is often high in barns housing young animals. One of the other treated free-stall barns (Richmond I) that also housed penned hogs and calves had significantly greater fly activity compared with all other barns. The two treated barns where fly activity was not significantly greater compared with the control barn were Richmond II (penned calves in barn that was kept very clean and dry) and Turner I (free-stall milking cows located on same farm as the calf hutch barn).

Despite these apparent environmental effects on fly activity, speck counts were negatively correlated with the previous week's parasitism rate in three barns: Richmond, Turner II, and the calf hutch barn. That is, when wasp activity was high (more fly pupae were killed by wasps), we saw the fly activity (speck counts) decline a week later. This effect on fly activity was not apparent in the control barn (as expected) nor in two of the treatment barns with low parasitism rates: Litchfield and Turner I. These results strongly suggest that the wasp release was effective in controlling a significant proportion of the house fly population in three of the five release locations (the calf hutches and the heifer barn).

Comparison of the Most Successful Sites with the Least Successful Sites. This comparison suggests some reasons why wasps were so effective in the calf hutches and less effective over the entire season in the other barns.

In the three barns where season-long parasitism was not sustained, peak parasitism reached 38% in one barn (Litchfield), 18% in another (Richmond), and 22% in the third (Turner I). In one of these barns (Richmond), the producers felt that the wasps were effective in controlling flies (and the low speck counts confirmed that fly activity was low) because they had better fly control than in previous years with no other changes in practices. It is possible that actual parasitism was high, but our monitoring methods

underestimated actual parasitism because the sentinel bags were placed outside of the calf pens.

Of the other two sites, one had a heavy rat infestation which may have interfered with wasp establishment. Many of our sentinel bags had rat-sized bites taken out of them and it is likely that rats also ate the parasitized pupae. In the third barn, milk cows were pastured during the day and the free-stall area was thoroughly cleaned out daily, so it is possible that parasitized pupae were cleaned out while unparasitized flies were brought in from outdoors with the cows each evening.

The barns where the wasps were most effective held penned heifers or individual calf hutches, suggesting that the wasps became better established where there was a residue of some manure and bedding. Also, since the wasps depend on the availability of fly pupae to complete their life cycle, and manure from young animals often supports more flies, it follows that the parasitic wasps can build up to higher numbers in barns housing young animals. Finally, the individual calf hutches probably provided protection and enclosure for the tiny parasites.

Producer Acceptance. Interviews held with producers during the project indicated that producers were pleased with the level of fly control achieved. Two of the four producers indicated that fly control was better this year compared with previous years. One producer reduced applications of pyrethrin insecticides for fly control from an average of 2.5 per season to a single application during 2001 for an average annual pesticide cost savings of $187.50. The other three participating producers have relied on cultural practices (good manure management in and around barns) and fly traps rather than insecticides in the past and therefore, would not have realized any cost savings by the addition of a wasp release to their normal fly management program.

A twelve-week program of weekly wasp releases costs about $216 per season ($13 + $5 shipping = $18/50 cows/week). By this calculation, the wasp release program presents an additional cost of $28.50 - $216 per season. Although wasps must be released each year in order to be effective, the cost is probably not a barrier to acceptance especially in calf hutches and pens where the wasps are more likely to provide longer lasting control of fly populations than insecticide sprays.

Conclusions

These results of this single-season demonstration showed that releases of *Muscidifurax raptor* and *Muscidifurax raptorellis*, natural enemies of the house fly, can be effective as part of a comprehensive fly management program in Maine dairy farms. This approach appears to be most effective when used in individual calf hutches or in barns with calf or heifer pens. It appears to be less effective in open barns housing milk cows. Producers interested in purchasing these parasitic wasps for fly control are urged to contact University of Maine Cooperative Extension or the Maine Department of Agriculture, Food and Rural Resources (Kathy Murray: 207-287-7616) for additional tips on ordering and using them. The Cornell University websites cited below also provide excellent information on this topic.

Acknowledgements

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